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texture. The neighbouring muscles appeared livid and lacerated.

The *os femoris* was become carious on its inferior and posterior parts; and, at about an inch distance above the condyle of that bone internally, there arose a considerable *exostosis*.

The capsular ligament of the knee-joint was become much thickened, and contained about two ounces of a viscid yellow *synovia*.

The femoral artery, on its inferior part, just above its division into *tibialis antica* and *postica*, was diseased; which disease extended four inches upwards.

The coats of the artery were considerably thickened, and lacerated longitudinally.

The smallest diameter of the diseased part of the artery was two inches and one quarter: the largest diameter of the diseased part of the artery was two inches and one half.

Hatton-Garden,
Nov. 17. 1757.

XLV. *Farther Experiments for increasing the Quantity of Steam in a Fire-Engine.*
By Keane Fitz-Gerald, Esq; F. R. S.

Read Nov. 24, 1757. **I** Gave a former account to the Royal Society of some experiments made for increasing the quantity of steam in a fire-engine, by blowing air thro' boiling water *. The effects

* See above, No. X. p. 53.

then evidently produced left me, and I believe many others, who came to view the experiments, no room to doubt the seeming cause. In which error I should probably have still remained, had not farther experiments demonstrated the mistake.

Whatever apology I ought to make this learned Society, for having given in that account prematurely, I believe their great regard to truth, which has always been the basis of their researches for the improvement of natural knowledge, will require none for this. I shall therefore, as briefly as I can, relate the further experiments, that were made, which evidently demonstrate the error of the former; and from which some phænomena have occurred, perhaps hitherto unknown.

In order to try what difference the air passing thro' a thinner body of water might occasion, I brought the horizontal pipe, which (as mentioned in the former account) was placed 12 inches under the surface of the water, to within six inches; and found, on setting the engine to work, that the leaden pipe, for the conveyance of air from the bellows into the boiler, became much hotter than I had perceived it before; which could not happen, if a constant cool air had passed thro': and on shutting the cock, which was fixed in the leaden pipe to hinder the steam from ascending into the bellows before the engine should be set to work, tho' no air could then possibly pass thro', yet the bellows still continued to move with the same regularity as before; which, on examination, was found defective on the inside, where the middle board, that divides the two bodies, was warped and cracked in several places, thro' which

the air passed very regularly from one body to the other at each stroke, instead of passing thro' the pipe into the boiler, as imagined. By this, the cause of deception was evident; which I was still in hopes of remedying, by having a new pair of bellows made, somewhat larger, and much stronger. When this was fixed, and the engine worked a few strokes, I was surprised to find the bellows did not come down, but remained fully charged with air, tho' it had 400 lb. weight upon it; and that, on increasing the weight gradually to 1400 lb. which was as much as the bellows could support, the air was not forced thro'.

I also made several experiments, by lowering the horizontal pipe two feet under the surface of the water, and raising it at different times to within four inches of the surface, and could not at any depth force the air thro', whilst the engine worked; but on opening the steam-pipe, which is a pipe for letting the steam pass from the boiler whenever the engine stops, the bellows could then readily force the air thro', tho' the water boiled ever so strong, and seemingly made a surprising increase of steam.

I had the leaden pipe to convey the air from the bellows, which was first put thro' the top into the boiler, carried on the outside, and passed horizontally into it, about the height the water generally stands, that by opening a cock, fixed for the purpose close to the boiler, I could readily discharge all the steam lodged in the pipe; and by shutting the cock, and making small holes at three or four inches distance, I could almost find the point, where the air and steam met in opposition, cool air being strongly expelled thro' one, and hot steam thro' the other.

It

It was also perceptible, that the air was impelled somewhat, tho' not considerably, more forward by the addition of each hundred weight on the bellows :

That the deeper the horizontal pipe was placed in the water, the less resistance was made by the steam :

That in proportion as the heat of the steam was increased, by making the water boil more strongly, the resistance to the pressure of the air by the weight on the bellows became greater.

It is a very doubtful matter, whether air forced thro' boiling water would have answered the purpose intended : but I believe it was never imagined, that air could not be readily forced thro', until proved by the foregoing experiments. The attempt, tho' it has failed demonstrably in that point, has produced the same effect from another cause, as to saving coals, and throwing up more water. For, by the constant care, that was taken during the time of making these experiments, to measure the coals, to admit only a proper quantity of fuel to be laid on, and also to mark the time exactly it took in burning ; the engine then did, and still continues to require eight bushels of coals less, in every 24 hours work, than it did before ; and also, from the regularity of its stroke, to throw up more water ; the same care being required from the engineer, who can have no pretence for consuming more coals now, than appeared sufficient during the time the experiments were making.

Tho' some of the properties of steam are well known ; yet the degrees of expansion it is capable of ;

of; whether air be mixed with, or necessary to, its formation; as also how far its power of resistance may reach; are probably not yet known, to a proper degree of exactness. Niewentit fixes the expansion of a cubical inch of water, converted into steam, at 13365, Dr. Defaguliers at 14000, and Mr. Payne at 4000 times. The great scope in this subject from a plenum to a vacuum, if I may be allowed the expression, as also the very useful purposes, to which it has already been, and possibly may be still further applied, will, I hope, be an inducement to those, who are much better qualified, to proceed in so useful an inquiry.

XLVI. *Observatio Eclipsis Lunæ Die 27 Martii, Ann. 1755. habita Uliffipone in Domo Patrum Congregationis Oratorii à Joanne Chevalier ejusdem Congregationis Presbytero, Regiæ Londinensis Societatis Socio, Regiæque Parisiensis Scientiarum Academiæ correspondente.*

Tubo optico 8 pedum peracta est observatio cœlo sereno, claroque.

IMMERSIONES.

Hora postmeridiana
temporis veri.

		h	'	"
Read Dec. 8, 1757.	Initium penumb rædubium	10	29	50
	Initium eclipsis dubium	10	33	35
Certe jam incæperat	— — —	10	34	05
Umbra ad mare humorum	— — —	10	44	00
			Umbra	